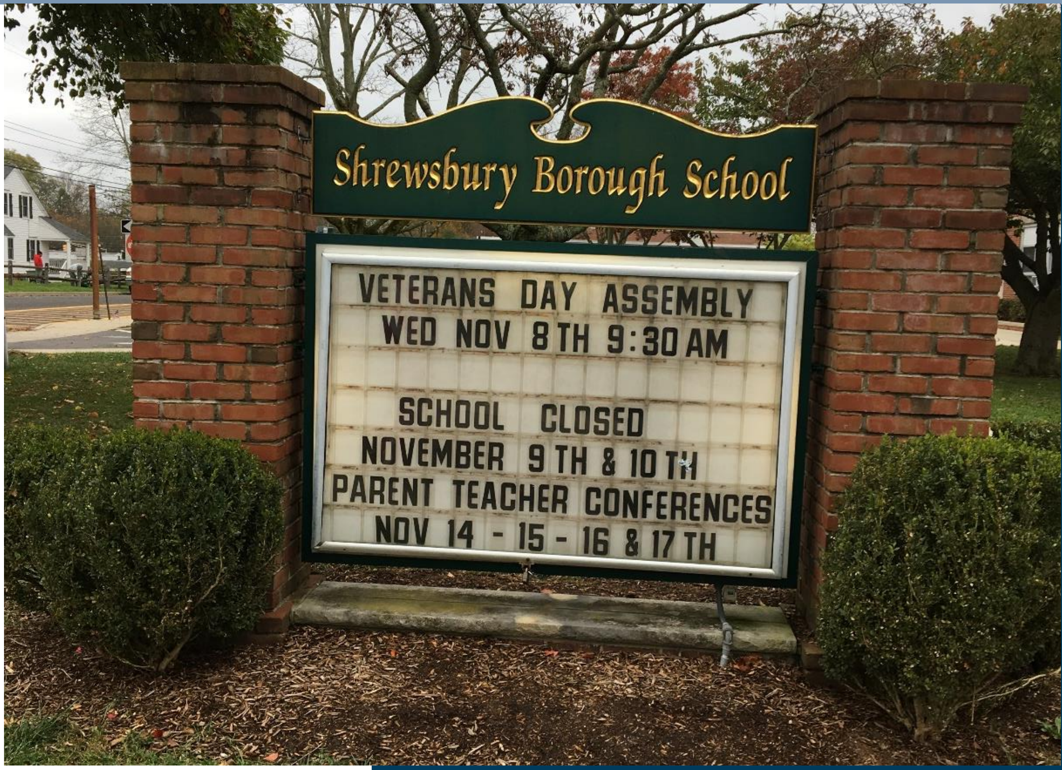
Local Government Energy Audit:
Energy Audit Report



Shrewsbury Borough School

20 Obre Place

Shrewsbury, NJ 07702

Shrewsbury Borough Board of Education

June 26, 2018

Final Report by:

TRC Energy Services

Disclaimer

The intent of this energy analysis report is to identify energy savings opportunities and recommend upgrades to the facility's energy using equipment and systems. Approximate saving are included in this report to help make decisions about reducing energy use at the facility. This report, however, is not intended to serve as a detailed engineering design document. Further design and analysis may be necessary in order to implement some of the measures recommended in this report.

The energy conservation measures and estimates of energy savings have been reviewed for technical accuracy. However, estimates of final energy savings are not guaranteed, because final savings may depend on behavioral factors and other uncontrollable variables. TRC Energy Services (TRC) and New Jersey Board of Public Utilities (NJBPU) shall in no event be liable should the actual energy savings vary.

Estimated installation costs are based on TRC's experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from *RS Means*. The owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Since actual installed costs can vary widely for certain measures and conditions, TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. The owner of the facility should review available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

Table of Contents

Table of Figures

1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Shrewsbury Borough School.

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey school districts in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

The careful evaluation of ECM's took into consideration information provided to TRC by the Shrewsbury Borough School. Special attention was given to the 2016 Referendum Resolution that outlines tentative capital planning for the Borough School while considering energy efficiency and associated project paybacks. Most items in the referendum related to energy efficiency were evaluated in this report.

1.1 Facility Summary

Shrewsbury Borough School is a 75,957 square foot facility comprised standard education space types including offices, classrooms, computer lab, library, and a gymnasium. The Shrewsbury Borough School does not have any commercial grade cooking equipment. The original school was built in 1952 and has been updated or received additions in 1957, 1994, and 2004 respectively.

The facility is used throughout the year by the community for a variety of events, but is mainly occupied as an elementary and middle school. The school operates for approximately 102 hours a week with an average occupancy of approximately 500 staff and students.

The lighting system at the Shrewsbury Borough School is in reasonably good condition in most areas. The most common fixture and lamp type is the linear fluorescent T8. There is a good opportunity to incur significant energy saving through an LED upgrade for all appropriate lamps and fixtures throughout the space.

Mechanical systems at the Shrewsbury Borough School vary in type. The base system from the original building is a distributed steam loop fed from two steam boilers in the mechanical room. The newer middle school wing utilizes these same boilers, but converts the steam to hot water through a heat exchanger and then distributes the hot water through the space for heating. The gym, library, and other distinct areas utilize packaged roof top units for heating and in some cases cooling. Steam boilers are challenging and inefficient in the generation of steam, control, and in the distribution of steam throughout a building. The full conversion to a hot water system was evaluated as part of this report.

Domestic hot water is provided to the school through three electric domestic hot water heaters with storage. These units are located mechanically designated rooms throughout the school.

Mechanical and lighting systems are generally controlled locally by a switch or a programmable thermostat. Some automated control is present in newer portions of the facility.

The building envelope at the Shrewsbury Borough School was for the most part observed to be in reasonable condition. The middle school, gym wing, and library appeared to be in the best condition as compared to the original building. The rolled rubber gym roof, and, rubber with white membrane roof were found to be on fair to good condition and under warranty. The pitched shingled roof over the elementary wing was found to be in fair condition. A roof mounted solar screening was conducted as part of this study. It is recommended that the roof, especially the original, be evaluated for replacement should the school move forward with a solar array.

The window types varied throughout the space depending on area and the last upgrade. A combination of single and double pane aluminum metal framed windows were observed throughout the building. A more robust capital improvement evaluation specific to the window system at the school is recommended.

A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated nine measures which together represent an opportunity for Shrewsbury Borough School to reduce annual energy costs by $44,637 and annual greenhouse gas emissions by 386,015 lbs CO_2e. We estimate that if all measures were implemented as recommended, the project would pay for itself in roughly 14.8 years. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce Shrewsbury Borough School's annual energy use by 26%.

Figure 1 – Previous 12 Month Utility Costs

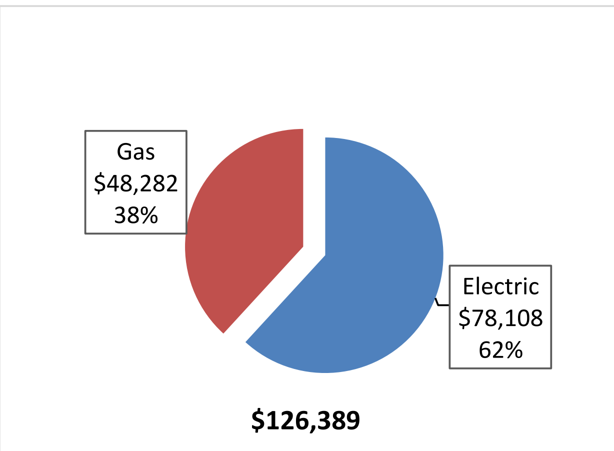
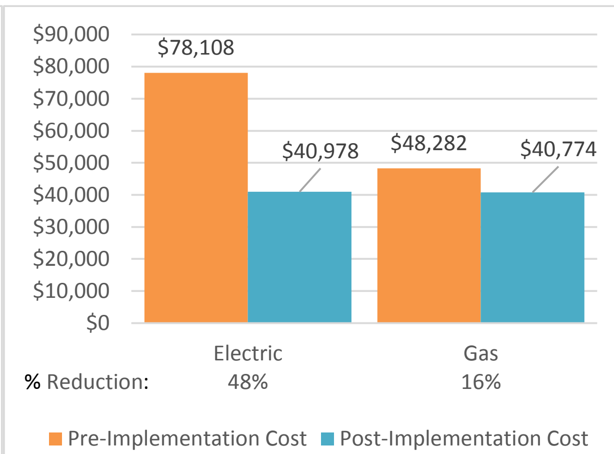


Figure 2 – Potential Post-Implementation Costs



A detailed description of Shrewsbury Borough School's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**246,908**	**26.5**	**0.0**	**$30,650.73**	**$95,718.09**	**$17,560.00**	**$78,158.09**	**2.5**	**248,635**
ECM 1	Install LED Fixtures	Yes	35,134	3.8	0.0	$4,361.43	$27,876.59	$900.00	$26,976.59	6.2	35,379
ECM 2	Retrofit Fixtures with LED Lamps	Yes	211,613	22.7	0.0	$26,269.29	$67,626.39	$16,660.00	$50,966.39	1.9	213,093
ECM 3	Install LED Exit Signs	Yes	161	0.0	0.0	$20.01	$215.11	$0.00	$215.11	10.8	162
Lighting Control Measures			**1,200**	**0.1**	**0.0**	**$149.02**	**$2,060.00**	**$280.00**	**$1,780.00**	**11.9**	**1,209**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	1,200	0.1	0.0	$149.02	$1,620.00	$210.00	$1,410.00	9.5	1,209
Motor Upgrades			**8,481**	**2.0**	**0.0**	**$1,052.85**	**$8,079.36**	**$0.00**	**$8,079.36**	**7.7**	**8,541**
ECM 5	Premium Efficiency Motors	Yes	8,481	2.0	0.0	$1,052.85	$8,079.36	$0.00	$8,079.36	7.7	8,541
Variable Frequency Drive (VFD) Measures			**39,074**	**7.5**	**0.0**	**$4,850.63**	**$14,829.50**	**$3,925.00**	**$10,904.50**	**2.2**	**39,348**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	Yes	19,655	5.5	0.0	$2,439.99	$7,615.90	$1,600.00	$6,015.90	2.5	19,793
ECM 7	Install VFDs on Boiler Feedwater Pumps	Yes	19,419	2.0	0.0	$2,410.65	$7,213.60	$2,325.00	$4,888.60	2.0	19,555
Electric Unitary HVAC Measures			**3,435**	**2.0**	**0.0**	**$426.43**	**$52,781.59**	**$2,415.50**	**$50,366.09**	**118.1**	**3,459**
ECM 8	Install High Efficiency Electric AC	Yes	3,435	2.0	0.0	$426.43	$52,781.59	$2,415.50	$50,366.09	118.1	3,459
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**724.5**	**$7,507.52**	**$523,000.00**	**$9,442.40**	**$513,557.60**	**68.4**	**84,824**
ECM 9	Install High Efficiency Hot Water Boilers	Yes	0	0.0	724.5	$7,507.52	$523,000.00	$9,442.40	$513,557.60	68.4	84,824
TOTALS			**299,100**	**38.1**	**724.5**	**$44,637.19**	**$696,468.55**	**$33,622.90**	**$662,845.65**	**14.8**	**386,015**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measure save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing older standard efficiency motors with high efficiency standard (NEMA Premium). Motors replacements generally assume the same size motors, just higher efficiency. Although occasionally additional savings can be achieved by downsizing motors to better meet current load requirements. This measure saves energy by reducing the power used by the motors, due to improved electrical efficiency.

Variable Frequency Drives (VFDs) are motor control devices. These measures control the speed of a motor so that the motor spins at peak efficiency during partial load conditions. Sensors adapt the speed to flow, temperature, or pressure settings which is much more efficient that usage a valve or damper to control flow rates, or running the motor at full speed when only partial power is needed. These measures save energy by controlling motor usage more efficiently.

Electric Unitary HVAC measures generally involve replacing older inefficient air conditioning systems with modern energy efficient systems. New air conditioning systems can provide equivalent cooling to older air condition systems at a reduced energy cost. These measures save energy by reducing the power used by the air conditioning systems, due to improved electrical efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

Energy Efficient Practices

TRC also identified 21 low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at Shrewsbury Borough School include:

- Reduce Air Leakage
- Close Doors and Windows
- Use Window Treatments/Coverings
- Perform Proper Lighting Maintenance
- Develop a Lighting Maintenance Schedule
- Ensure Lighting Controls Are Operating Properly
- Turn Off Unneeded Motors
- Reduce Motor Short Cycling
- Perform Routine Motor Maintenance
- Use Fans to Reduce Cooling Load
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Ensure Economizers are Functioning Properly
- Clean Evaporator/Condenser Coils on AC Systems
- Clean and/or Replace HVAC Filters
- Check for and Seal Duct Leakage
- Repair/Replace Steam Traps
- Perform Proper Boiler Maintenance
- Perform Proper Water Heater Maintenance
- Install Plug Load Controls
- Replace Computer Monitors
- Water Conservation

For details on these energy efficient practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for Shrewsbury Borough School. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	150	kW DC STC
Electric Generation	112,867	kWh/yr
Displaced Cost	$9,820	/yr
Installed Cost	$390,000	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Direct Install
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Pay for Performance - Existing Building (P4P)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 7.

This facility may also qualify for the Direct Install program which can provide turnkey installation of multiple measures, through an authorized network of participating contractors. This program can provide substantially higher incentives that SmartStart, up to 70% of the cost of selected measures, although measure eligibility will have to be assessed and be verified by the designated Direct Install contractor and, in most cases, they will perform the installation work.

Larger facilities with an interest in a more comprehensive whole building approach to energy conservation should consider participating in the Pay for Performance (P4P) program. Projects eligible for this project program must meet minimum savings requirements. Final incentives are calculated based on actual measured performance achieved at the end of the project. The application process is more involved, and it requires working with a qualified P4P contractor, but the process may result in greater energy savings overall and more lucrative incentives, up to 50% of project's total cost.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (ESIP). Supported directly by the NJBPU, ESIP provides government agencies with project development, design, and implementation support services, as well as, attractive financing for implementing ECMs. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 7.5 for additional information on the ESIP Program.

Additional information on relevant incentive programs is located in Section 7 or: www.njcleanenergy.com/ci.

2 Facility Information and Existing Conditions

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Debi Avento	Business Administrator	aventod@sbs-nj.org	732-747-0887
TRC Energy Services			
Brian Dattellas	Auditor	bdattellas@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On November 8, 2017, TRC performed an energy audit at Shrewsbury Borough School located in Shrewsbury, New Jersey. TRC's team met with Debi Avento and Michael Tillet to review the facility operations and help focus our investigation on specific energy-using systems.

Shrewsbury Borough School is a 75,957 square foot facility comprised standard education space types including offices, classrooms, computer lab, library, and a gymnasium. The Shrewsbury Borough School does not have any commercial grade cooking equipment. The original school was built in 1952 and has been updated or received additions in 1957, 1994, and 2004 respectively.

The facility is used throughout the year by the community for a variety of events, but is mainly occupied as an elementary and middle school. The school operates for approximately 102 hours a week with an average occupancy of approximately 500 staff and students.

The lighting system at the Shrewsbury Borough School is in reasonably good condition in most areas. The most common fixture and lamp type is the linear fluorescent T8. Mechanical systems at the Shrewsbury Borough School vary in type. The base system from the original building is a distributed steam loop fed from two steam boilers in the mechanical room. The newer middle school wing utilizes these same boilers, but converts the steam to hot water through a heat exchanger and then distributes the hot water through the space for heating. The gym, library, and other distinct areas utilize packaged roof top units for heating and in some cases cooling.

Domestic hot water is provided to the school through three electric domestic hot water heaters with storage located at designated locations throughout the school.

Mechanical and lighting systems are generally controlled locally by a switch or a programmable thermostat. Some automated control is present in newer portions of the facility.

The building envelope at the Shrewsbury Borough School was for the most part observed to be in reasonable condition. The middle school, gym wing, and library appeared to be in the best condition as compared to the original building. The rolled rubber gym roof, and rubber with white membrane roof were found to be on fair to good condition. The pitched shingled roof over the elementary wing was found to be in fair condition. The window types varied throughout the space depending on area and the last upgrade. A combination of single and double pane aluminum framed windows were observed throughout the building.

2.3 Building Occupancy

The school building is open seven days a week. The typical schedule is presented in the table below. The entire facility is used year round. During a typical day, the facility is occupied by approximately 100 staff and 400 students.

Figure 6 - Building Schedule

Building Occupancy Schedule		
Building Name	**Weekday/Weekend**	**Operating Schedule**
Shrewsbury Borough School	Weekday	6:30am - 11:30pm
Shrewsbury Borough School	Weekend	6:30am - 11:30pm

2.4 Building Envelope

Outer Wall Middle School

The Shrewsbury Borough School building envelope was found to be in good condition. The facility is essentially four unique space types with independent mechanical systems. The original structure, the gym, the library, and the middle school.

The original building built in 1952 has a brick façade that is clean and well maintained. In most areas single pane aluminum framed windows were the observed with some infiltration. A small number of windows in the original building were in poor condition and should be replaced. Evaluation of these windows resulted in long paybacks suggesting this should be considered as a capital investment rather than an energy efficiency project.

The roof above the original building is comprised of three types of rubber material. The back elementary wing has residential style shingles that were in fair condition. The front wing of building has a rolled rubber roof with a white reflective membrane. No recommendations were made roof replacement as the majority of the roof is in sound condition and still under warranty However the school may want to consider replacement of the shingles and white membrane if they choose to move forward with a roof mounted solar project.

The building envelope for gym and library areas of Shrewsbury Borough School were found to be in good condition. Both areas also have a brick facade with some concrete reinforcement. The window system for the library was observed to be aluminum framed single and double paned. The roofing system is rolled rubber black roofing above the Gym, and rolled rubber with some white membrane above the library.

The middle school has a brick facade that was observed to be in good condition. The window system for the middle school is made up of aluminum framed single and double paned windows that looked to be in good condition. Site staff mentioned that there have been some issues with infiltration with certain windows at the middle school. The school may want to consider further investigation to determine if there are significant issues with the middle school window system. The age of these windows, costs associated with replacement, and current estimated u-values indicate that replacement of these windows should be considered a capital improvement rather than and energy efficiency project. The roof at the middle school is rolled rubber with a white reflective membrane. The roof was observed to be in good condition.

2.5 On-Site Generation

Shrewsbury Borough School has 125 kW generator on site that is used only in the case of an emergency.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Typical Hallway Lighting

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL). Outdoor fixtures are made up of Metal halides and LED fixtures. Indoor fixtures are 2-lamp or 3-lamp, 4-foot long troffers with diffusers and lenses. The majority of the control for the lighting system is done through a manual wall switch.

An LED re-lamp has been recommended as part of this study. At this point it is recommended that the existing fixtures remain in place and LED lamps replace the existing fluorescent lamps.

As requested the existing LED lighting in the gymnasium was evaluated for replacement. Based on energy usage, new fixture costs, and lumen requirements for gymnasiums there is no recommendation for changing these fixtures out.

Hot Water (or Steam) Heating System

The steam system consists of two H.B. Smith 2,146 kBtu/hr output, forced draft boilers. The boilers have a nominal combustion efficiency of 75%. Each boiler has a 7.5 hp feed water pump and a control valve that maintains water level in the boiler. Steam is supplied to the facility at 15 psig.

Existing Boilers

The boilers appear to operate in a lead/lag configuration. Only a single boilers is required to meet the facility heating demand. Boiler operation is rotated daily. Steam is supplied directly to steam coils located in unit ventilators in classrooms throughout the original building.

For the middle school wing the steam boilers are used to produce steam which is the converted to hot water through a heat exchanger. Hot water coils are the fed the hot water so to provide heating within the middle school space.

The boilers are close to the end of their useful life.

Full Conversion to Hot Water

ECM 9 Install High Efficiency Hot Water Boilers presents the biggest challenge for the Shrewsbury Borough School. Two options were evaluated related to the hot water system at Shrewsbury Borough School.

Option 1

Replace the existing steam boiler that has almost completed its useful life with a new more efficient steam boiler. This option allows for the school to keep the existing infrastructure for the steam distribution in the original building. There would be minimal disruption in the classroom space with this measure. Analysis completed as part of this study indicates a payback of approximately 45 years (not included in ECM table). This is due to the minimum efficiency gain on the new steam boiler compared to the old boiler (75%-81%), and the costs associated with the new boiler.

Option 2 (recommended with additional evaluation, in ECM table)

Replace existing steam boilers with high efficiency condensing hot water boilers. If implemented the entire facility would be converted to hot water. This would require upgrades to pumping, controls, and comfort heating infrastructure. These costs are significant and need to be more clearly defined beyond what is presented in this study. We recommend getting a contractor to provide a quote to determine if the project is viable. That said, the pay back for this project in this study is 68.4 years. The new hot water system could be 15% more efficient than the existing steam system, and would be much easier to control.

Direct Expansion Air Conditioning System (DX)

There are 11 direct-expansion (DX) package units in various positions on the roof servicing the facility. Most of these units are equipped with a gas fired furnace and an outside air economizer.

Units are controlled by a programmable thermostats located in the designated space that they service.

The majority of these units were found to be operational and in good working condition.

Typical RTU

Domestic Hot Water Heating System

The domestic hot water heating system for the facility consists of three electric domestic hot water heaters with a combined storage capacity of approximately 150 gallons.

Building Plug Load

There are approximately 250 computer, and/or laptops located in the library computer lab and on mobile carts used in the classrooms. About half of these computers are desktop units with LCD monitors. There is no centralized PC power management software installed.

There is one server closest located in room 426 cooled by a small split system.

The facility has a variety of printers and audio visual equipment that are used for classroom instruction, and general office needs.

2.7 Water-Using Systems

There are 10 restrooms at this facility. All restrooms have been recently updated with low flow devices.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and natural gas was analyzed to identify opportunities for savings. In addition, data for electricity and natural gas was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

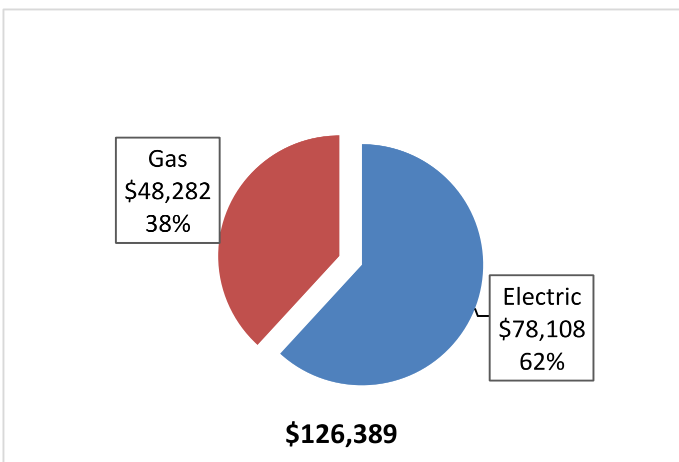
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 7 - Utility Summary

Utility Summary for Shrewsbury Borough School		
Fuel	**Usage**	**Cost**
Electricity	629,200 kWh	$78,108
Natural Gas	46,590 Therms	$48,282
Total		**$126,389**

The current annual energy cost for this facility is $126,389 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by JCP&L. The average electric cost over the past 12 months was $0.124/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 9 - Electric Usage & Demand

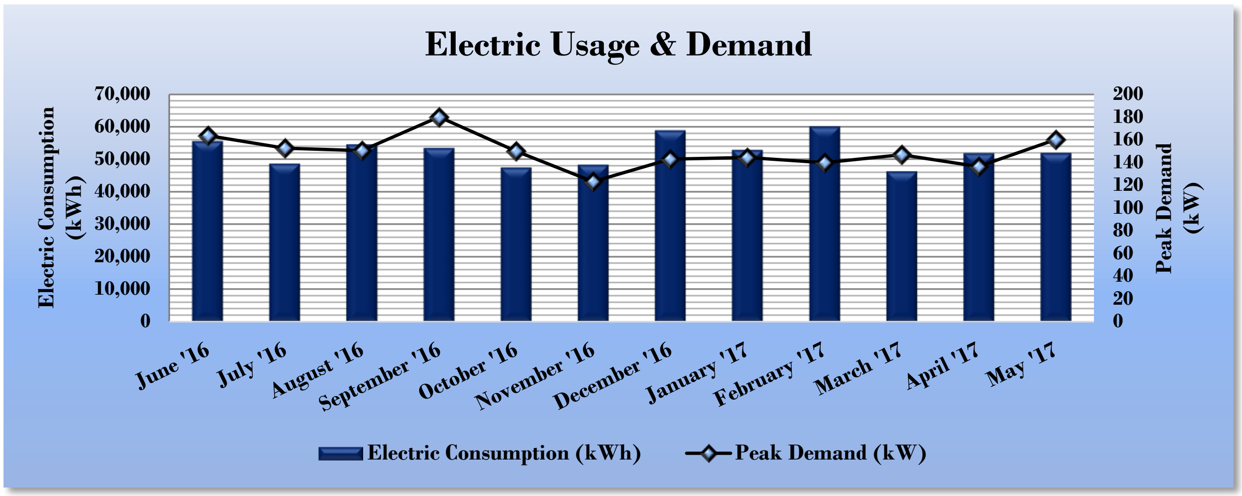


Figure 10 - Electric Usage & Demand

Electric Billing Data for Shrewsbury Borough School					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
7/7/16	31	55,500	164	$939	$6,760
8/5/16	29	48,600	153	$917	$5,983
9/6/16	32	54,500	151	$905	$6,723
10/6/16	30	53,400	180	$1,011	$6,708
11/7/16	32	47,400	150	$790	$5,846
12/7/16	30	48,300	123	$691	$5,842
1/9/17	33	58,800	143	$842	$7,109
2/7/17	29	52,800	145	$957	$6,640
3/9/17	30	60,000	140	$784	$6,787
4/6/17	28	46,200	147	$824	$5,460
5/6/17	30	51,800	136	$765	$8,069
6/6/17	31	51,900	160	$962	$6,180
Totals	**365**	**629,200**	**180.2**	**$10,386**	**$78,108**
Annual	**365**	**629,200**	**180.2**	**$10,386**	**$78,108**

3.3 Natural Gas Usage

Natural Gas is provided by NJ Natural Gas. The average gas cost for the past 12 months is $1.036/term, which is the blended rate used throughout the analyses in this report. The monthly gas consumption is shown in the chart below.

Figure 11 - Natural Gas Usage

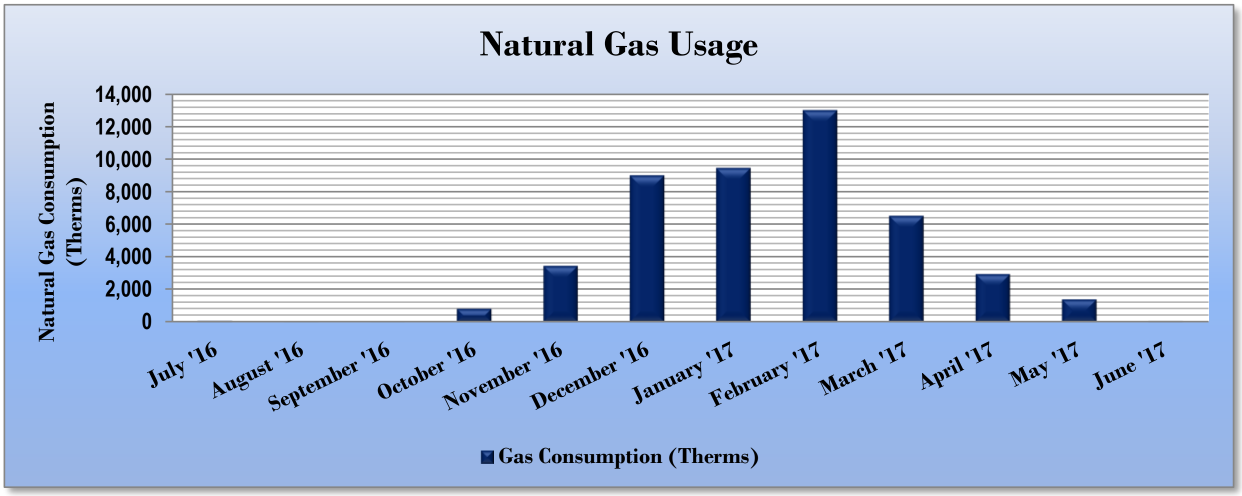


Figure 12 - Natural Gas Usage

Gas Billing Data for Shrewsbury Borough School			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
7/21/16	31	37	$828
8/18/16	28	4	$802
9/16/16	29	3	$802
10/18/16	32	798	$1,595
11/16/16	29	3,446	$3,951
12/20/16	34	8,997	$8,917
1/19/17	30	9,451	$8,345
2/19/17	31	12,988	$11,170
3/22/17	31	6,519	$6,004
4/20/17	29	2,938	$3,145
5/19/17	29	1,382	$1,903
6/20/17	32	27	$821
Totals	**365**	**46,590**	**$48,282**
Annual	**365**	**46,590**	**$48,282**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. EUI is presented in terms of "site energy" and "source energy." Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region.

Figure 13 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	Shrewsbury Borough School	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	153.2	262.6
Site Energy Use Intensity (kBtu/ft^2)	89.6	130.7

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 14 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	Shrewsbury Borough School	National Median Building Type: Higher Education - Public
Source Energy Use Intensity (kBtu/ft^2)	101.0	262.6
Site Energy Use Intensity (kBtu/ft^2)	66.6	130.7

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75 percent of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. This facility has a current score of 43.

A Portfolio Manager Statement of Energy Performance (SEP) was generated for this facility, see Appendix B: ENERGY STAR® Statement of Energy Performance.

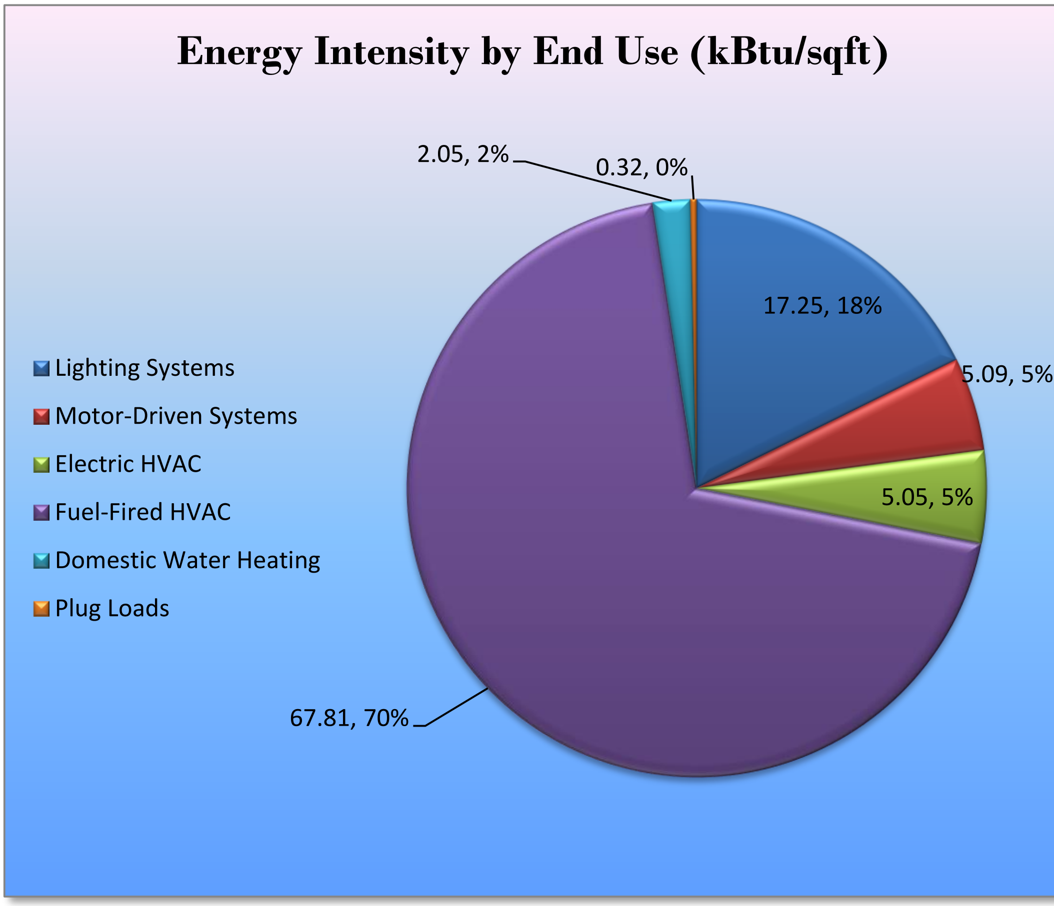
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager regularly, so that you can keep track of your building's performance. Free online training is available to help you use ENERGY STAR® Portfolio Manager to track your building's performance at: https://www.energystar.gov/buildings/training.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 15 - Energy Balance (% and kBtu/SF)



4 Energy Conservation Measures

Level of Analysis

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the Shrewsbury Borough School regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 7.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 16 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**246,908**	**26.5**	**0.0**	**$30,650.73**	**$95,718.09**	**$17,560.00**	**$78,158.09**	**2.5**	**248,635**
ECM 1	Install LED Fixtures	35,134	3.8	0.0	$4,361.43	$27,876.59	$900.00	$26,976.59	6.2	35,379
ECM 2	Retrofit Fixtures with LED Lamps	211,613	22.7	0.0	$26,269.29	$67,626.39	$16,660.00	$50,966.39	1.9	213,093
ECM 3	Install LED Exit Signs	161	0.0	0.0	$20.01	$215.11	$0.00	$215.11	10.8	162
Lighting Control Measures		**1,200**	**0.1**	**0.0**	**$149.02**	**$1,620.00**	**$210.00**	**$1,410.00**	**9.5**	**1,209**
ECM 4	Install Occupancy Sensor Lighting Controls	1,200	0.1	0.0	$149.02	$1,620.00	$210.00	$1,410.00	9.5	1,209
Motor Upgrades		**8,481**	**2.0**	**0.0**	**$1,052.85**	**$8,079.36**	**$0.00**	**$8,079.36**	**7.7**	**8,541**
ECM 5	Premium Efficiency Motors	8,481	2.0	0.0	$1,052.85	$8,079.36	$0.00	$8,079.36	7.7	8,541
Variable Frequency Drive (VFD) Measures		**39,074**	**7.5**	**0.0**	**$4,850.63**	**$14,829.50**	**$3,925.00**	**$10,904.50**	**2.2**	**39,348**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	19,655	5.5	0.0	$2,439.99	$7,615.90	$1,600.00	$6,015.90	2.5	19,793
ECM 7	Install VFDs on Boiler Feedwater Pumps	19,419	2.0	0.0	$2,410.65	$7,213.60	$2,325.00	$4,888.60	2.0	19,555
Electric Unitary HVAC Measures		**3,435**	**2.0**	**0.0**	**$426.43**	**$52,781.59**	**$2,415.50**	**$50,366.09**	**118.1**	**3,459**
ECM 8	Install High Efficiency Electric AC	3,435	2.0	0.0	$426.43	$52,781.59	$2,415.50	$50,366.09	118.1	3,459
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**724.5**	**$7,507.52**	**$523,000.00**	**$9,442.40**	**$513,557.60**	**68.4**	**84,824**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	724.5	$7,507.52	$523,000.00	$9,442.40	$513,557.60	68.4	84,824
TOTALS		**299,100**	**38.1**	**724.5**	**$44,637.19**	**$696,028.55**	**$33,552.90**	**$662,475.65**	**14.8**	**386,015**

* - All incentives presented in this table are based on NJ Smart Start Building equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

** - Simple Payback Period is based on net measure costs (i.e. after incentives).

4.1.1 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 17 below.

Figure 17 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**246,908**	**26.5**	**0.0**	**$30,650.73**	**$95,718.09**	**$17,560.00**	**$78,158.09**	**2.5**	**248,635**
ECM 1	Install LED Fixtures	35,134	3.8	0.0	$4,361.43	$27,876.59	$900.00	$26,976.59	6.2	35,379
ECM 2	Retrofit Fixtures with LED Lamps	211,613	22.7	0.0	$26,269.29	$67,626.39	$16,660.00	$50,966.39	1.9	213,093
ECM 3	Install LED Exit Signs	161	0.0	0.0	$20.01	$215.11	$0.00	$215.11	10.8	162

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	9,759	1.0	0.0	$1,211.51	$12,249.51	$500.00	$11,749.51	9.7	9,828
Exterior	25,374	2.7	0.0	$3,149.92	$15,627.08	$400.00	$15,227.08	4.8	25,552

Measure Description

We recommend replacing existing fixtures containing fluorescent lamps and fixtures with new high performance LED light fixtures. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 2: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	211,613	22.7	0.0	$26,269.29	$67,626.39	$16,660.00	$50,966.39	1.9	213,093
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing fluorescent lamps with LED lamps. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of a fluorescent tubes and more than 10 times longer than many incandescent lamps.

ECM 3: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	161	0.0	0.0	$20.01	$215.11	$0.00	$215.11	10.8	162
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing all incandescent or compact fluorescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.1.2 Lighting Control Measures

Our recommendations for lighting control measures are summarized in Figure 18 below.

Figure 18 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**1,200**	**0.1**	**0.0**	**$149.02**	**$1,620.00**	**$210.00**	**$1,410.00**	**9.5**	**1,209**
ECM 4	Install Occupancy Sensor Lighting Controls	1,200	0.1	0.0	$149.02	$1,620.00	$210.00	$1,410.00	9.5	1,209

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 4: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
1,200	0.1	0.0	$149.02	$1,620.00	$210.00	$1,410.00	9.5	1,209

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in all restrooms. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.1.3 Motor Upgrades

Our recommendations for motor upgrades are summarized in Figure 19 below.

Figure 19 – Summary of Motor Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**8,481**	**2.0**	**0.0**	**$1,052.85**	**$8,079.36**	**$0.00**	**$8,079.36**	**7.7**	**8,541**
ECM 5	Premium Efficiency Motors	8,481	2.0	0.0	$1,052.85	$8,079.36	$0.00	$8,079.36	7.7	8,541

ECM 5: Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
8,481	2.0	0.0	$1,052.85	$8,079.36	$0.00	$8,079.36	7.7	8,541

Measure Description

We recommend replacing standard efficiency motors with *NEMA Premium™* efficiency motors. Our evaluation assumes that existing motors will be replaced with motors of equivalent size and type. Although occasionally additional savings can be achieved by downsizing motors to better meet the motor's current load requirements. The base case motor efficiencies are estimated from nameplate information and our best estimates of motor run hours. Efficiencies of proposed motor upgrades are obtained from the New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016). Savings are based on the difference between baseline and proposed efficiencies and the assumed annual operating hours.

4.1.4 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 20 below.

Figure 20 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**39,074**	**7.5**	**0.0**	**$4,850.63**	**$14,829.50**	**$3,925.00**	**$10,904.50**	**2.2**	**39,348**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	19,655	5.5	0.0	$2,439.99	$7,615.90	$1,600.00	$6,015.90	2.5	19,793
ECM 7	Install VFDs on Boiler Feedwater Pumps	19,419	2.0	0.0	$2,410.65	$7,213.60	$2,325.00	$4,888.60	2.0	19,555

ECM 6: Install VFDs on Constant Volume (CV) HVAC

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
19,655	5.5	0.0	$2,439.99	$7,615.90	$1,600.00	$6,015.90	2.5	19,793

Measure Description

We recommend installing variable frequency drives (VFDs) to control exhaust fan motor speeds to convert a constant-volume. A separate VFD is usually required to control the return fan motor or dedicated exhaust fan motor. Zone thermostats will cause the VFD to modulate fan speed to maintain the appropriate ventilation in the zone, while maintaining a constant supply air temperature. Energy savings results from reducing fan speed (and power) when there is a reduced load required for the zone. The magnitude of energy savings is based on the estimated amount of time that fan motors operate at partial load.

ECM 7: Install VFDs on Boiler Feed water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
19,419	2.0	0.0	$2,410.65	$7,213.60	$2,325.00	$4,888.60	2.0	19,555

Measure Description

We recommend installing variable frequency drives (VFD) to control boiler feed water pumps. The existing level control valve will need to be maintained fully open and its control signal used by the VFD to modulate the feed water speed. Energy savings results from reducing pump motor speed (and power) at reduced feed water flow. The magnitude of energy savings is based on the estimated amount of time that the pumping system will operate at reduced load.

4.1.5 Electric Unitary HVAC Measures

Our recommendations for unitary HVAC measures are summarized in Figure 21 below.

Figure 21 - Summary of Unitary HVAC ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures		**3,435**	**2.0**	**0.0**	**$426.43**	**$52,781.59**	**$2,415.50**	**$50,366.09**	**118.1**	**3,459**
ECM 8	Install High Efficiency Electric AC	3,435	2.0	0.0	$426.43	$52,781.59	$2,415.50	$50,366.09	118.1	3,459

ECM 8: Install High Efficiency Air Conditioning Units

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
3,435	2.0	0.0	$426.43	$52,781.59	$2,415.50	$50,366.09	118.1	3,459

Measure Description

We recommend replacing standard efficiency packaged air conditioning units with high efficiency packaged air conditioning units. There have been significant improvements in both compressor and fan motor efficiencies over the past several years. Therefore, electricity savings can be achieved by replacing older units with new high efficiency units. A higher EER or SEER rating indicates a more efficient cooling system. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average cooling load, and the estimated annual operating hours. This was included in the study as a request. Paybacks associated with the replacement of the identified units are extremely long due to the operation of the units included.

4.1.6 Gas-Fired Heating System Replacements

Our recommendations for gas-fired heating system replacements are summarized in Figure 22 below.

Figure 22 - Summary of Gas-Fired Heating Replacement ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**724.5**	**$7,507.52**	**$523,000.00**	**$9,442.40**	**$513,557.60**	**68.4**	**84,824**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	724.5	$7,507.52	$523,000.00	$9,442.40	$513,557.60	68.4	84,824

ECM 9: Install High Efficiency Hot Water Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	724.5	$7,507.52	$523,000.00	$9,442.40	$513,557.60	68.4	84,824

Measure Description

We recommend replacing older inefficient hot water boilers with high efficiency hot water boilers. Energy savings result from improved combustion efficiency and reduced standby losses at low loads.

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies between 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. The boiler efficiency increases as the return water temperature drops below 130°F. Therefore, condensing hydronic boilers were only evaluated when the return water temperature is less than 130°F during most of the operating hours. As a result condensing hydronic boilers are recommended for this site, but will require engineering design to verify the ability to operate in condensing mode.

In order to accommodate the condensing boiler conversion Shrewsbury School will need to address a number of infrastructure issues outlined below. It is important to consider all aspects of the conversion as the cost will ultimately impact the associated paybacks.

Recommendations

- Replace existing steam boilers with gas-fired condensing hot water boilers.
- Convert system from Steam to Hot Water.
- Replace terminal steam coils in unit ventilators with terminal hot water coils or new fan coils.
- Replace steam piping with hot water piping.
- Install hot water pump and motors.

Additional Considerations for Further Investigation (Requires Engineering Design Effort)

- Proposed boiler sizing and distribution system sizing and configuration
- Proposed hot water device sizing and distribution system pipe sizing
- The ability to operate the new system in condensing mode

5 Energy Efficient Practices

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Close Doors and Windows

Ensure doors and windows are closed in conditioned spaces. Leaving doors and windows open leads to a significant increase in heat transfer between conditioned spaces and the outside air. Reducing a facility's air changes per hour (ACH) can lead to increased occupant comfort as well as significant heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Use Window Treatments/Coverings

A substantial amount of heat gain can occur through uncovered or untreated windows, especially older single pane windows and east or west-facing windows. Treatments such as high-reflectivity films or covering windows with shades or shutters can reduce solar heat gain and, consequently, cooling load and can reduce internal heat loss and the associated heating load.

Perform Proper Lighting Maintenance

In order to sustain optimal lighting levels, lighting fixtures should undergo routine maintenance. Light levels decrease over time due to lamp aging, lamp and ballast failure, and buildup of dirt and dust on lamps, fixtures and reflective surfaces. Together, these factors can reduce total illumination by 20% - 60% or more, while operating fixtures continue drawing full power. To limit this reduction, lamps, reflectors and diffusers should be thoroughly cleaned of dirt, dust, oil, and smoke film buildup approximately every 6 – 12 months.

Develop a Lighting Maintenance Schedule

In addition to routine fixture cleaning, development of a maintenance schedule can both ensure maintenance is performed regularly and can reduce the overall cost of fixture re-lamping and re-ballasting. By re-lamping and re-ballasting fixtures in groups, lighting levels are better maintained and the number of site visits by a lighting technician or contractor can be minimized, decreasing the overall cost of maintenance.

Ensure Lighting Controls Are Operating Properly

Lighting controls are very cost effective energy efficient devices, when installed and operating correctly. As part of a lighting maintenance schedule, lighting controls should be tested annually to ensure proper functioning. For occupancy sensors, this requires triggering the sensor and verifying that the sensor's timer settings are correct. For daylight sensors, maintenance involves cleaning of sensor lenses and confirming set points and sensitivity are appropriately configured.

Turn Off Unneeded Motors

Electric motors often run unnecessarily, and this is an overlooked opportunity to save energy. These motors should be identified and turned off when appropriate. For example, exhaust fans often run unnecessarily when ventilation requirements are already met. Reducing run hours for these motors can result in significant energy savings. Whenever possible, use automatic devices such as twist timers or occupancy sensors to ensure that motors are turned off when not needed.

Reduce Motor Short Cycling

Frequent stopping and starting of motors subjects rotors and other parts to substantial stress. This can result in component wear, reducing efficiency, and increasing maintenance costs. Adjust the load on the motor to limit the amount of unnecessary stopping and starting to improve motor performance.

Perform Routine Motor Maintenance

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of cleaning surfaces and ventilation openings on motors to prevent overheating, lubricating moving parts to reduce friction, inspecting belts and pulleys for wear and to ensure they are at proper alignment and tension, and cleaning and lubricating bearings. Consult a licensed technician to assess these and other motor maintenance strategies.

Use Fans to Reduce Cooling Load

Utilizing ceiling fans to supplement cooling is a low cost strategy to reduce cooling load considerably. Thermostat settings can be increased by 4°F with no change in overall occupant comfort when the wind chill effect of moving air is employed for cooling.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating set points and increase cooling set points). Cooling load can be reduced further by increasing the facility's occupied set point temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

Ensure Economizers are Functioning Properly

Economizers, when properly configured, can be used to significantly reduce mechanical cooling. However, if the outdoor thermostat or enthalpy control is malfunctioning or the damper is stuck or improperly adjusted, benefits from the economizer may not be fully realized. As such, periodic inspection and maintenance is required to ensure proper operation. This maintenance should be scheduled with maintenance of the facility's air conditioning system and should include proper setting of the outdoor thermostat/enthalpy control, inspection of control and damper operation, lubrication of damper connections, and adjustment of minimum damper position. A malfunctioning economizer can significantly increase the amount of heating and mechanical cooling required by introducing excess amounts of cold or hot outside air.

Clean Evaporator/Condenser Coils on AC Systems

Dirty evaporators and condensers coils cause a restriction to air flow and restrict heat transfer. This results in increased evaporator and condenser fan load and a decrease in cooling system performance. Keeping the coils clean allows the fans and cooling system to operate more efficiently.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Check for and Seal Duct Leakage

Duct leakage in commercial buildings typically accounts for 5% to 25% of the supply airflow. In the case of rooftop air handlers, duct leakage can occur to the outside of the building, significantly increasing cooling and heating costs. By sealing sources of leakage, cooling, heating, and ventilation energy use can be reduced significantly, depending on the severity of air leakage.

Repair/Replace Steam Traps

Properly functioning steam traps ensure that all latent heat in the steam is delivered to the end use by preventing pressurized steam from leaking. Steam traps should be inspected as part of the regular steam system maintenance. Traps that are blocked, venting, or allowing steam to leak through should be repaired or replaced. Repairing or replacing existing steam traps will reduce steam losses.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Proper Water Heater Maintenance

At least once a year, drain a few gallons out of the water heater using the drain valve. If there is a lot of sediment or debris, then a full flush is recommended. Turn the temperature down and then completely drain the tank. Once a year check for any leaks or heavy corrosion on the pipes and valves. For gas water heaters, check the draft hood and make sure it is placed properly, with a few inches of air space between the tank and where it connects to the vent. Look for any corrosion or wear on the gas line and on the piping. If you noticed any black residue, soot or charred metal, this is a sign you may be having combustion issues and you should have the unit serviced by a professional. For electric water heaters, look for any signs of leaking such as rust streaks or residue around the upper and lower panels covering the electrical components on the tank. For water heaters over three to four years old have a technician inspect the sacrificial anode annually.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to “Plug Load Best Practices Guide” http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Replace Computer Monitors

Replacing old computer monitors or displays with efficient monitors will reduce energy use. ENERGY STAR® rated monitors have specific requirements for on mode power consumption as well as idle and sleep mode power. According to the ENERGY STAR® website monitors that have earned the ENERGY STAR® label are 25% more efficient than standard monitors.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gallons per minute (gpm) for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. Any reduction in water use does however ultimately reduce grid level electricity use since a significant amount of electricity is used to deliver water from reservoirs to end users. The EPA WaterSense™ ratings for urinals is 0.5 gallons per flush (gpf) and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

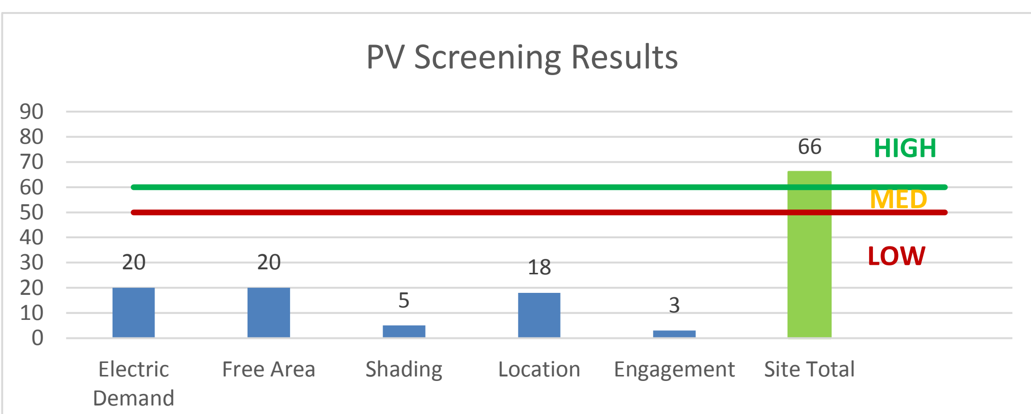
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has a High potential for installing a PV array.

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the main building, gym, middle school, and library may be feasible. If Shrewsbury Borough School is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 23 - Photovoltaic Screening



Potential	High	
System Potential	150	kW DC STC
Electric Generation	112,867	kWh/yr
Displaced Cost	$9,820	/yr
Installed Cost	$390,000	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program (SRP) prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 7.4 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: http://www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

7 Project Funding / Incentives

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 24 for a list of the eligible programs identified for each recommended ECM.

Figure 24 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings
ECM 1	Install LED Fixtures	X		X	X
ECM 2	Retrofit Fixtures with LED Lamps	X		X	X
ECM 3	Install LED Exit Signs	X		X	X
ECM 4	Install Occupancy Sensor Lighting Controls	X		X	X
ECM 5	Premium Efficiency Motors	X		X	X
ECM 6	Install VFDs on Constant Volume (CV) HVAC	X		X	X
ECM 7	Install VFDs on Boiler Feedwater Pumps	X		X	X
ECM 8	Install High Efficiency Electric AC	X		X	X
ECM 9	Install High Efficiency Hot Water Boilers	X		X	X

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

7.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom Measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less. Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

Detailed program descriptions, instructions for applying and applications can be found at: www.njcleanenergy.com/SSB.

7.2 Direct Install

Overview

Direct Install is a turnkey program available to existing small to medium-sized facilities with a peak electric demand that does not exceed 200 kW for any recent 12-month period. You will work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures, up to $125,000 per project. Direct Install participants will also be held to a fiscal year cap of $250,000 per entity.

How to Participate

To participate in the Direct Install program you will need to contact the participating contractor who the region of the state where your facility is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. The contractor will be paid the measure incentives directly by the program which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Since Direct Install offers a free assessment of eligible measures, Direct Install is also available to small businesses and other commercial facilities too that may not be eligible for the more detailed facility audits provided by LGEA.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

7.3 Pay for Performance - Existing Buildings

Overview

The Pay for Performance – Existing Buildings (P4P EB) program is designed for larger customers with a peak demand over 200 kW in any of the preceding 12 months. Under this program the minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings. P4P is a generally a good option for medium to large sized facilities looking to implement as many measures as possible under a single project in order to achieve deep energy savings. This program has an added benefit of evaluating a broad spectrum of measures that may not otherwise qualify under other programs. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also utilize the P4P program.

Incentives

Incentives are calculated based on estimated and achieved energy savings ranging from $0.18-$0.22/kWh and $1.80-$2.50/therm, capped at the lesser of 50% total project cost, or $1 million per electric account and $1 million per natural gas account, per fiscal year, not to exceed $2 million per project. An incentive of $0.15/square foot is also available to offset the cost of developing the Energy Reduction Plan (see below) contingent on the project moving forward with measure installation.

How to Participate

To participate in the P4B EB program you will need to contact one of the pre-approved consultants and contractors ("Partners"). Under direct contract to you, the Partner will help further evaluate the measures identified in this report through development of the Energy Reduction Plan (ERP), assist you in implementing selected measures, and verify actual savings one year after the installation. At each of these three milestones your Partner will also facilitate securing program incentives.

Approval of the final scope of work is required by the program prior to installation completion. Although installation can be accomplished by a contractor of your choice (some P4P Partners are also contractors) or by internal personnel, the Partner must remain involved to ensure compliance with the program guidelines and requirements.

Detailed program descriptions, instructions for applying, applications and list of Partners can be found at: www.njcleanenergy.com/P4P.

7.4 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

7.5 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs can be leveraged to help further reduce the total project cost of eligible measures.

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an Energy Services Company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the Energy Savings Plan (ESP) can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program descriptions and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

8 Energy Purchasing and Procurement Strategies

8.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third party (i.e. non-utility) energy supplier.

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. So, though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third party supplier, consider shopping for a reduced rate from third party electric suppliers. If your facility is purchasing electricity from a third party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

8.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey has also been deregulated. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. The utility provides basic gas supply service (BGSS) to customers who choose not to buy from a third party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

If your facility is not purchasing natural gas from a third party supplier, consider shopping for a reduced rate from third party natural gas suppliers. If your facility is purchasing natural gas from a third party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Electric Service 109	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	3	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.12	1,080	0.0	$134.02	$229.60	$60.00	1.27
Electric Service 109	2	Exit Signs: Fluorescent	None	14	8,760	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	161	0.0	$20.01	$215.11	$0.00	10.75
Roof Access	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.09	854	0.0	$106.01	$382.67	$100.00	2.67
Gym	24	LED - Fixtures: High-Bay	Wall Switch	59	5,304	None	No	24	LED - Fixtures: High-Bay	Wall Switch	59	5,304	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Gym	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Café	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	6	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.11	1,025	0.0	$127.21	$459.20	$120.00	2.67
106 Storage	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	6	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.11	1,025	0.0	$127.21	$459.20	$120.00	2.67
204/205	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.04	342	0.0	$42.40	$153.07	$40.00	2.67
Outdoor gym Awnig	10	High-Pressure Sodium: (1) 150W Lamp	Wall Switch	188	5,304	Fixture Replacement	Yes	10	LED - Fixtures: Architectural Flood/Spot Luminaire	Wall Switch	28	5,304	1.05	9,759	0.0	$1,211.51	$12,469.51	$535.00	9.85
Outer Wall Packs	40	Metal Halide: (1) 100W Lamp	Wall Switch	128	5,304	Fixture Replacement	Yes	40	LED - Fixtures: Security	Wall Switch	24	5,304	2.73	25,374	0.0	$3,149.92	$15,847.08	$435.00	4.89
KG hall	18	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	18	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.70	6,478	0.0	$804.14	$1,377.60	$360.00	1.27
203	5	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.06	579	0.0	$71.93	$382.67	$100.00	3.93
203	5	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.19	1,799	0.0	$223.37	$382.67	$100.00	1.27
201	5	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.06	579	0.0	$71.93	$382.67	$100.00	3.93
201	5	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.19	1,799	0.0	$223.37	$382.67	$100.00	1.27
202	5	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,304	Relamp	No	5	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.06	579	0.0	$71.93	$382.67	$100.00	3.93
300	17	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	17	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.31	2,903	0.0	$360.42	$1,301.07	$340.00	2.67
300	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	5,304	Relamp	No	3	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.11	988	0.0	$122.67	$229.60	$60.00	1.38
Nurse	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	3	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.06	512	0.0	$63.60	$229.60	$60.00	2.67
Boys Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	Yes	4	LED - Linear Tubes: (4) 3' Lamps	Occupancy Sensor	42	3,713	0.09	795	0.0	$98.74	$613.73	$35.00	5.86
Girls Bathroom	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	Yes	4	LED - Linear Tubes: (4) 3' Lamps	Occupancy Sensor	42	3,713	0.09	795	0.0	$98.74	$613.73	$35.00	5.86
Janitors Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.02	171	0.0	$21.20	$76.53	$20.00	2.67
CST	11	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	11	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.43	3,959	0.0	$491.42	$841.87	$220.00	1.27
33	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
307	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
307	2	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,304	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.02	232	0.0	$28.77	$153.07	$40.00	3.93
309	6	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	6	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.23	2,159	0.0	$268.05	$459.20	$120.00	1.27
310	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
311	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
312	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
313	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
314	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
Starwell	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.04	342	0.0	$42.40	$153.07	$40.00	2.67
Basement	7	Linear Fluorescent - T12: 4' T12 (40W) - 1L	None	46	5,304	Relamp	No	7	LED - Linear Tubes: (4) 2' Lamps	None	34	5,304	0.06	512	0.0	$63.60	$535.73	$140.00	6.22
Crawl Space	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.04	342	0.0	$42.40	$153.07	$40.00	2.67
Primary Lobby	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	8	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.15	1,366	0.0	$169.61	$612.27	$160.00	2.67
Primary Lobby	3	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	5,304	Relamp	No	3	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.16	1,464	0.0	$181.73	$229.60	$60.00	0.93
Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	114	5,304	Relamp	No	4	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.21	1,952	0.0	$242.30	$306.13	$80.00	0.93
Office	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	8	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.31	2,879	0.0	$357.40	$612.27	$160.00	1.27
Staff Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.02	171	0.0	$21.20	$76.53	$20.00	2.67
Staff Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	4	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.15	1,440	0.0	$178.70	$306.13	$80.00	1.27
Staff Room	1	Linear Fluorescent - T8: 2' T8 (17W) - 3L	Wall Switch	53	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.01	116	0.0	$14.39	$76.53	$20.00	3.93
400's Hallway	30	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	30	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	1.16	10,796	0.0	$1,340.23	$2,296.00	$600.00	1.27
405	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.29	2,733	0.0	$339.22	$1,224.53	$320.00	2.67
404	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
Boys Bathroom	2	LED - Fixtures: Ambient - 4' - Direct Fixture	Wall Switch	17	5,304	None	Yes	2	LED - Fixtures: Ambient - 4' - Direct Fixture	Occupancy Sensor	17	3,713	0.01	62	0.0	$7.72	$270.00	$35.00	30.43
Girls Bathroom	2	LED - Fixtures: Ambient - 3' - Direct Fixture	Wall Switch	17	5,304	None	Yes	2	LED - Fixtures: Ambient - 3' - Direct Fixture	Occupancy Sensor	17	3,713	0.01	62	0.0	$7.72	$270.00	$35.00	30.43
407	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
Mens Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.02	171	0.0	$21.20	$76.53	$20.00	2.67
Janitors Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.04	360	0.0	$44.67	$76.53	$20.00	1.27

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Debbies Office	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
414	8	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	8	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.15	1,366	0.0	$169.61	$612.27	$160.00	2.67
Boiler Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.02	171	0.0	$21.20	$76.53	$20.00	2.67
Boiler Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	6	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.11	1,025	0.0	$127.21	$459.20	$120.00	2.67
416	22	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	22	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.40	3,757	0.0	$466.43	$1,683.73	$440.00	2.67
417	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
418	14	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	14	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.26	2,391	0.0	$296.82	$1,071.47	$280.00	2.67
419	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
421	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
420	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.22	2,049	0.0	$254.42	$918.40	$240.00	2.67
Jr High Hall	15	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	15	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.28	2,562	0.0	$318.02	$1,148.00	$300.00	2.67
Facalty	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	7	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.13	1,196	0.0	$148.41	$535.73	$140.00	2.67
500	10	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	10	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.39	3,599	0.0	$446.74	$765.33	$200.00	1.27
502	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
501	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
503	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
505	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
507	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
508	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
506	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
504	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
423	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
424	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
Music Room	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	7	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.13	1,196	0.0	$148.41	$535.73	$140.00	2.67
Halway	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	4	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.15	1,440	0.0	$178.70	$306.13	$80.00	1.27

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Back Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	6	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.11	1,025	0.0	$127.21	$459.20	$120.00	2.67
Back Room	17	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	17	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.66	6,118	0.0	$759.46	$1,301.07	$340.00	1.27
425	15	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	15	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.58	5,398	0.0	$670.12	$1,148.00	$300.00	1.27
425	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	4	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.15	1,440	0.0	$178.70	$306.13	$80.00	1.27
425	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
428	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
Jr.. High Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	Yes	3	LED - Linear Tubes: (4) 3' Lamps	Occupancy Sensor	42	3,713	0.13	1,164	0.0	$144.47	$527.80	$35.00	3.41
Jr. High Bathroom	3	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	Yes	3	LED - Linear Tubes: (4) 3' Lamps	Occupancy Sensor	42	3,713	0.13	1,164	0.0	$144.47	$527.80	$35.00	3.41
430	12	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	12	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.46	4,319	0.0	$536.09	$918.40	$240.00	1.27
Library	16	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.62	5,758	0.0	$714.79	$1,224.53	$320.00	1.27
Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	93	5,304	Relamp	No	2	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.08	720	0.0	$89.35	$153.07	$40.00	1.27
Library Lobby	15	Compact Fluorescent: Can Light	Wall Switch	14	5,304	Relamp	No	15	LED Screw-In Lamps: LED Screw In	Wall Switch	4	5,304	0.10	915	0.0	$113.58	$3,819.06	$300.00	30.98
Computer Lab	40	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	40	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.73	6,832	0.0	$848.06	$3,061.33	$800.00	2.67
Computer Lab	48	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	48	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.88	8,198	0.0	$1,017.67	$3,673.60	$960.00	2.67
Computer Lab	16	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	5,304	Relamp	No	16	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	5,304	0.29	2,733	0.0	$339.22	$1,224.53	$320.00	2.67
Parking Lot	24	LED - Fixtures: Outdoor Post-Mount	None	28	5,304	None	No	24	LED - Fixtures: Outdoor Post-Mount	None	28	5,304	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room Pumps	Middle School	2	Heating Hot Water Pump	7.5	85.0%	No	3,391	No	85.0%	Yes	2	1.98	19,419	0.0	$2,410.65	$7,213.60	$2,325.00	2.03
Roof Top Exhaust	Middle School	3	Exhaust Fan	0.5	85.0%	No	2,745	No	85.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Exhaust	Middle School	2	Exhaust Fan	1.0	83.0%	No	2,745	No	83.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Exhaust	Middle School	2	Exhaust Fan	3.0	83.0%	No	2,745	Yes	89.5%	No		0.22	806	0.0	$100.09	$1,609.68	$0.00	16.08
Roof Top Exhaust	Main Original	4	Exhaust Fan	1.0	83.0%	No	2,745	No	83.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Exhaust	Main Original	3	Exhaust Fan	0.5	85.0%	No	2,745	No	85.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Exhaust	Pitched Roof	3	Exhaust Fan	3.0	83.0%	No	2,745	Yes	89.5%	No		0.33	1,209	0.0	$150.14	$2,414.52	$0.00	16.08
Roof Top Exhaust	Pitched Roof	2	Exhaust Fan	1.0	83.0%	No	2,745	No	83.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof Top Exhaust	Pitched Roof	4	Exhaust Fan	0.5	83.0%	No	2,745	No	83.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Gym	Gym	2	Supply Fan	10.0	80.0%	No	3,391	Yes	91.7%	Yes	2	6.66	25,102	0.0	$3,116.12	$10,750.00	$1,600.00	2.94
Storage Room	Middle School	1	Heating Hot Water Pump	5.0	87.0%	No	2,745	No	87.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Back Side Roof	Gym Area	1	Exhaust Fan	5.0	80.0%	No	2,745	Yes	89.5%	No		0.27	1,019	0.0	$126.48	$921.06	$0.00	7.28

Electric HVAC Inventory & Recommendations

		Existing Conditions					Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency (COP)	Install Dual Enthalpy Economizer?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Roof	RTU 5 / LIB	1	Packaged AC	12.00		Yes	1	Packaged AC	12.00		11.50		No	0.00	0	0.0	$0.00	$16,726.20	$948.00	0.00
Roof	Offices	1	Split-System AC	2.50		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	RTU 6	1	Packaged AC	5.00		Yes	1	Packaged AC	5.00		14.00		No	0.62	1,054	0.0	$130.81	$11,344.80	$460.00	83.21
Roof	RTU 7	1	Packaged AC	5.00		Yes	1	Packaged AC	5.00		14.00		No	0.62	1,054	0.0	$130.81	$11,344.80	$460.00	83.21
Roof	Main Building	1	Packaged AC	3.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Main Building Back Side	1	Packaged AC	7.50		Yes	1	Packaged AC	7.50		11.50		No	0.79	1,328	0.0	$164.82	$13,365.79	$547.50	77.77
Roof	Main Building Back Side	1	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Main Building Back Side	1	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Main Building Back Side	1	Packaged AC	5.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Main Building Back Side	1	Packaged AC	1.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Roof	Gym	2	Packaged Terminal AC	20.00		No							No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	School	2	Induced Draft Steam Boiler	2,146.00	Yes	2	Condensing Hot Water Boiler	2,146.00	91.00%	Et	0.00	0	724.5	$7,507.52	$523,000.00	$9,442.40	68.41

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Storage	Middle School	1	Storage Tank Water Heater (≤ 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Middle School LIB	2	Projectors Hanging	250.0	No
Middle School LIB	2	Printer	400.0	No
Middle School LIB	45	Computers	80.0	No
Middle School LIB	1	AV	20.0	Yes
Main Building / Office	1	Printer	250.0	No
Main Building / Office	2	Printer	400.0	No
Main Building / Office	14	Computers	80.0	No
Misc Classrooms	45	Computers	80.0	No

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

43

ENERGY STAR® Score[1]

Shrewsbury School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 75,957
Built: 1952

For Year Ending: July 31, 2017
Date Generated: January 21, 2018

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address
Shrewsbury School
20 Obre Place
Shrewsbury, New Jersey 07702

Property Owner
Shrewsbury School
20 Obre Place
Shrewsbury, NJ 07702

Primary Contact
Brian Dattellas
900 U.S. 9
Woodbridge, NJ 07095
732-855-0033
bdattellas@trcsolutions.com

Property ID: 6204916

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
89.4 kBtu/ft²

Source EUI
152.5 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	2,132,105 (31%)
Natural Gas (kBtu)	4,658,792 (69%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	84.4
National Median Source EUI (kBtu/ft²)	144
% Diff from National Median Source EUI	6%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	484

Signature & Stamp of Verifying Professional

I ________________ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: ____________________ Date: __________

Licensed Professional

Brian Dattellas
900 U.S. 9
Woodbridge, NJ 07095
732-855-0033 bdattellas@trcsolutions.com

Professional Engineer Stamp (if applicable)